DOCUMENT RESUME

ED 403 147 SE 059 641

AUTHOR Koballa, Thomas R., Jr.; And Others
TITLE WOWBugs: Materials Development and Classroom Implementation of a Novel Organism.
SPONS AGENCY National Science Foundation, Arlington, VA.
PUB DATE 96
CONTRACT ESI-9353040
NOTE 27p.
PUB TYPE Reports - Research/Technical (143)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Biological Sciences; Cooperation; *Educational Strategies; *Entomology; Intermediate Grades; Junior High Schools; Middle Schools; Science Activities; *Scientific Concepts; Student Attitudes; Teaching Methods
IDENTIFIERS *Wasps

ABSTRACT

The purpose of the WOWBug project was to promote "Melittobia digitata," a fruit-fly sized wasp, as a new organism for life science instruction and to determine the potential usefulness of the wasp to teach fundamental life science concepts. Fifty-five middle school teachers were introduced to the WOWBug and practiced with prototype activities in preparation for using them with their life science classes. Preliminary results indicate that the teachers' reasons for participating in the project varied greatly and that they recognized few barriers to teaching life science concepts in the areas of animal behavior, reproduction, and life cycles using the WOWBug. Over the period of one school year, the teachers' concerns about implementing the WOWBug activities in their classes shifted from those related to their personal needs to concerns about collaboration with other teachers and the effects of the activities on student learning. Benefits of the project include enhanced student interest in the life sciences and better understanding of life science concepts. (Author)

WOWBugs: Materials Development and Classroom Implementation of a Novel Organism

Thomas R. Koballa, Jr.
Lynda R. Flage
Eric J. Pyle
Department of Science Education

Robert W. Matthews
Sara Ranger
Department of Entomology

The University of Georgia

Running Head: WOWBug

The works described in this article was supported by the National Science Foundation Grant No. ESI-9353040.

Abstract

The purpose of the WOWBug project was to promote *Melittobia digitata*, a fruit-fly size wasp, as a new organism for life science instruction and to determine the potential usefulness of the wasp to teach fundamental life science concepts. Fifty-five middle school teachers were introduced to the WOWBug and practiced with prototype activities in preparation for using them with their life science classes. Preliminary results indicate that the teachers' reasons for participating in the project varied greatly and that they recognized few barriers to teaching life science concepts in the areas of animal behavior and reproduction, and life cycles using the WOWBug. Over the period of one school year, the teachers' concerns about implementing WOWBug activities in their classes shifted from those releated to their personal needs to concerns about collaboration with other teachers and the effects of the activities on student learning. Benefits of the project include enhanced student interest in life science and better understanding of select life science concepts.

The demands of middle school life science teaching require that laboratory activities be relatively short, hassle-free, and capable of capturing student interest. Using living organisms under such conditions is difficult at best, and for organisms with complex requirements their use is simply not feasible. In the case of vertebrate laboratory animals, escalating costs and animal welfare concerns have caused some teachers to curtail the use of such animals in classroom practice. Constraints such as these have made the use of insects a cost-effective and time-efficient alternative to more complex organisms. However, the relatively small number of model insects that are available for use in middle school classrooms have limitations that make them less than desirable for illustrating important biological concepts. For example, crickets are, loud, hyperactive, and difficult to handle; cockroaches and flies are considered unsanitary; mealworm beetles take months to complete their life cycle; and *Drosophilia* may fly away or die if improperly anesthetized.

In contrast, *Melittobia digitata* is a small, rapidly developing parasitic wasp that completes its life cycle in 14 to 18 days. It is incapable of stinging humans. *Melittobia* lays its eggs on the external surface of its host and the eggs can be easily viewed and counted under low magnification with proper lighting. Adults show extreme sexual dimorphism, making it easy to distinguish male from female. The amber-colored, eyeless male with its short dumpy wings cannot fly, and the black female is more inclined to hop than fly. It is for these reasons and others that we have begun to call *Melittobia digitata* the WOWBug™ and promote it as a versatile new model insect for teaching various life science concepts.

Purpose

The purpose of this article is three fold. First, we will describe the project goals and design, and in so doing tell more about the star of our work, *Melittobia digitata*. Next, we will describe several activities that use *Melittobia* to promote the learning of life science concepts. These activities are being field-tested by middle school life science teachers and their students and should soon be available for use by others. Finally, we will share some preliminary findings of our

project evaluation. These findings focus on activity development, teacher education, and implementation in middle school classrooms.

Project Description

This project is a two-year materials development effort supported by the National Science Foundation that involves scientists, science educators, and middle school teachers and their students. The goals of the project are to (1) develop and field-test WOWBug teaching materials, (2) research and refine in vitro rearing methods for the WOWBug, and (3) promote and publicize the WOWBug as a significant new organism for life science instruction. With the completion of the first year of the project, we wish to share some results with a wider audience.

The project was kicked off with a 50 minute workshop session at the annual meeting of the Georgia Science Teachers Association in February, 1994. From that meeting, we recruited 12 teachers for the Development Team from rural, suburban, and urban school districts from across Georgia. At the first Development Team meeting in April, 1994 the teachers conducted some fledgling WOWBug activities, learned about the WOWBug biology and culture maintenance, established a suggested format for logbook entries, and brainstormed ideas for additional activities and for efficient and inexpensive rearing methods. The teachers agreed to try some of the fledgling activities with their classes and to keep written records of their experiences and ideas for improvement.

The Development Team met again in June, 1994. This day-long session was organized to allow the teachers to report on their experiences with the fledgling activities and to demonstrate and describe other activities that they developed on their own and tried with their classes. Two teacher-developed activities, one on sex ratio determination and another on responses of the wasp to different stimuli, were presented and improvements were suggested. Further discussion focused on rearing methods, WOWBug anatomy, students' use of microscopes, and a number of other topics. Themes that emerged from hours of activity and discussion include:

- students thoroughly enjoyed working with the WOWBug;
- the WOWBug cultures are easy to maintain;

- mud dauber puparia are easily collected and work well as WOWBug hosts;
- the WOWBug is indeed harmless;
- classroom schedules can be accommodated by refrigerating the WOWBug;
- the WOWBug egg is difficult to see;
- the Brock Magiscope™ [1] is ideally suited for student observation of the WOWBug larvae, pupa, and adult stages; and
- the WOWBug can be used to teach many important biological concepts.

During the final hours of the session, the Development Team worked in two and three member groups to write brief descriptions of prototype activities that could be used to teach one or more life science concepts. The ideas for most of the activities originated from that day's discussion, and diskette copies of the brief descriptions were produced and collected at the end of the session.

Besides working with the Development Team, we were involved in a number of other tasks during the early months of the project. One task was to begin tests of artificial diet formulations for rearing *Melittobia*. In nature *Melittobia* typically parasitizes nests of various solitary wasps and bees, and in the laboratory a wide range of hosts have been shown suitable for successfully rearing it. The inability to maintain parasitic insects separate from their hosts has historically inhibited their widespread use as a model insect for life science instruction. However, recent advances related to the rearing of parasitic insects promise to make in vitro rearing of *Melittobia* routine in the future (Rotundo, Cavalloro, & Tremblay, 1988; Greany, Ferkovich, & Clark, 1989). Tests of artificial rearing methods by the entomologist members of the project staff are in progress and will be reported elsewhere. Until such time that a suitable artificial diet formulation is available, we continue to use either field collected organ-pipe mud dauber (*Trypoxylon politum*) prepupae or blow fly (*Sarcophaga bullata*) puparia, which can be purchased from biological supply companies, as hosts.

A second task was to recruit teachers for the project "Pilot Group," and to plan and conduct a two-day workshop for these teachers. Recruiting efforts included placing an ad in the Spring 1994

1 The Brock Magiscope is a product of Brock Optical, Inc., 441 Lake Howell Road, Maitland, FL 32751-5907 (1-800-780-9111).

issues of *The Georgia Science Teacher*, taking nominations from Development Team members, and soliciting teachers' names from district curriculum and science coordinators and middle school principals. Forty-three teachers, 10 more than had been initially planned for, participated in the two-day workshop in August 1994. The Development Team experiences helped to shape the plans for the workshop and team members provided considerable leadership. The workshop activities mirrored many of the experiences of the Development Team during earlier sessions and were greatly enhanced by the commentary shared by Development Team members regarding their own classroom experiences with the WOWBug.

Choosing a user-friendly name for *Melittobia digitata* was one of the many interesting tasks in which we engaged. In the proposal to the National Science Foundation, the name "FastWasp" was used to note the organism's rapid life cycle. During our early meetings with the Development Team, we realized that this name was unsuitable. Knowledge that the organism is a wasp affected students' responses when they were asked to identify the insect based on observable characteristics and seemed to remove the suspense associated with other discovery-oriented activities. Additionally, the name "FastWasp" caused those unacquainted with *Melittobia* to think of it as a fast flying insect capable of delivering a harmful sting. For example, our university's Office of Protection of Human Subjects initially requested that we have plenty of "bee sting" kits on hand during the summer teacher workshop. While other names including "FastBug," " Hopper," and "WHATIZZIT" were considered, we have chosen to use the name WOWBug because it avoids the problems associated with our previous choice.

Prototype WOWBug Activities

Prior to the August 1994 workshop, another important task was to develop 10 prototype activities. The project team began this task by meeting four weeks before the Pilot Group workshop to discuss the brief activity descriptions written by the Development Team. We agreed upon a uniform format for the activities, and decided that each of us should try to draft one or two complete activities. Two subsequent meetings and much writing and editing resulted in the production of 10 prototype activities in a standardized format.

Each activity targets a science concept from the areas of animal behavior, reproduction, interaction, communication or life cycles; addresses one or more science process skills; and has both student and teacher pages. All are investigative in nature and involve students in manipulating materials and asking questions. The student pages includes a problem statement, safety suggestions, a materials list, activity procedures, and questions. The teacher pages provide the same student information plus sections on relevant content, pre-activity preparations, student prerequisites, answers to the student questions, an evaluation task, and suggestions for extension activities. The complete activities were copied, assembled into binders, and distributed to the Pilot Group for field-testing with their classes during the 1994-95 school year. A brief description of each of the ten activities follows:

1. Interaction between organisms that live together in a particular habitat is the focus of an activity entitled "Mud Dauber Nest Ecology." In this activity, students dismantle the nests of mud daubers, a principle host organism for the WOWBug, and discover and identify a variety of other arthropods. They learn that a mud dauber nest is a microcosm of the processes occurring continuously in larger ecosystems. A dichotomous key to arthropod inhabitants of mud dauber nests is provided.

2. In "Determining the Ratio of Female to Male Bugs" students count male and female *Melittobia* pupae and find that the ratio of males to females is not 1:1 as in humans, but closer to 5 males to 95 females.

3. Students investigate the cause of sex determination of WOWBug in a related activity entitled "Sex Determination and Reproduction in *Melittobia digitata*". They learn that the birth of a male or female is entirely based on whether or not the egg is fertilized.

4. Students are challenged to determine the most effective and efficient methods to "round up" *Melittobia* that have been released on a desk top in "Get Along Little Buggies! or *Melittobia digitata* Round Up!". They discover that WOWBugs are photosensitive and move toward light, and this discovery often influences the choice and relative success of "round up" strategies.

5. In "Hoppin'Bug Connect-A-Dot", students discover that adult WOWBugs tend to walk and hop, rather than fly. By marking the spots where hopping WOWBugs land with a pencil or ink

dot and later connecting them, students can measure and then calculate the average hop distance traveled by a WOWBug over time, as well as create interesting shapes and images.

6. As students investigate the structure and function of the WOWBug's external body parts in "External Anatomy of *Melittobia digitata*," they learn a great deal about basic insect anatomy and discover the extreme sexual dimorphism exhibited by this organism. Students are often surprised to learn that females are black and have long wings and compound eyes, while males are amber in color and have reduced wings and no eyes.

7. In the "Life Cycle of *Melittobia digitata*," an extended investigation lasting three weeks, students make periodic observations of WOWBugs, beginning with the egg. Their observations reveal that the WOWBug undergoes complete metamorphosis with a life cycle that includes larval, pupal, and adult stages.

8. Students extend their understanding of the WOWBug life cycle and study the effects of temperature differences on the development of *Melittobia* in "Heh!! Who's Playing with My Thermostat?". Observation of diapause in *Melittobia* and discussion of what triggers this period of slowed metabolism is a likely outcome of this inquiry-oriented investigation.

9. In "Decisions, Decisions...or The Lady and the Tiger" students use an easily constructed choice tunnel to investigate the preferences WOWBugs have for common stimuli, including perfume, sugar, colored light, and rock music. While investigating preferences in this activity, students also practice the skills associated with designing controlled experiments in which only one variable is manipulated at a time.

10. "Say, What's for Dinner?" is an activity in which students investigate the question, "Does the choice of insect host affect the life cycle of the WOWBug?". It is a questions for which no scientific research has been reported. In the activity, students gather insect larvae to tests as hosts, learn that the WOWBug may be reared on many different host species ranging from cockroaches to flies to honey bees, and perhaps make a contribution to the body of scientific knowledge about the relationship between host choice and WOWBug development.

Preliminary Evaluation Results

Three aspects of the project are addressed in the preliminary evaluation findings reported here. First, the composition and initial activities of the Development Team and Pilot Group are described. Next, the teachers' assessment of the August, 1994 workshop and their concerns related to implementation are presented. Finally, a glimpse of one teacher's attempt to guide middle school students through a WOWBug experience is described.

Development Team and Pilot Group

Recall that the 12 members of the Development Team were selected from among the participants in a introductory workshop at the annual meeting of the Georgia Science Teachers Association in February, 1994 and the forty-three Pilot Group teachers were recruited from across the State of Georgia by various means. Together the Development Team and Pilot Group members represented something of a cross-section, albeit limited, of the middle school science teachers in the state.

The demographics of Development Team and Pilot Group were very similar as can be seen in Table 1. The majority of teachers were from metropolitan Atlanta systems, with coastal Georgia county systems also well represented. South Georgia was less well represented, with north Georgia systems and those within 30 miles of Athens, the site of all Team and Group meetings, providing only seven teachers.

Insert Table 1 about here.

The majority of the members of both groups were seventh grade teachers, with the remaining teaching fifth, sixth, eighth grade, or high school science. All of the Development Team member were middle grades certified. Among the Pilot Group, the vast majority held middle grades certification, while fewer held secondary or elementary certification. In considering their highest degree, better than half the teachers in both groups had received bachelor's degrees, while others held Master's degrees and Specialist's degrees. One teacher in the Pilot Group had received a doctorate. In addition, the majority of both groups had had a middle grades major in their undergraduate work, while the remainder were distributed among general science, elementary

education, physical education, business, English, sociology, and technology. A large number of teachers did not report an undergraduate major.

Two major age groups were distinctly represented by the members of the Development Team and Pilot Group. Thirty-two members of both groups were 35 to 49 years old, with 17 in the range 20 to 34 years. Only six teachers in the Pilot Group were age 50 or older. When compared with years of teaching experience, however, 34 of the 55 teachers in both groups had 10 years of experience or less, suggesting that many of them began teaching after age 22. Even more interestingly, 40 the teachers had less than 10 years experience teaching science.

Both the Development Team and Pilot Group members had had little prior training in entomology. Among the Development Team, 8 had no prior entomology training, while 2 had received some training from a teacher inservice. Only two members had had any formal coursework. Among the Pilot Group, 4 in 5 had no prior training in entomology. This is contrasted by the amount of time reported by the teachers as having been spent on teaching entomology. The majority of the Development Team reported spending at least 2 weeks teaching entomology, while most Pilot Group members reported spending three weeks or more teaching entomology. The reported entomology instruction time expenditures are found in Table 2.

Insert Table 2 about here.

The reasons teachers chose to participate in the WOWBug project varied. All Development Team members sought to improve their teaching of life science. Also, most sought to obtain instructional materials and to interact with scientists. About half of them reported an interest in entomology as influencing their motivation to participate in the WOWBug project. By comparison, the major reasons given by Pilot Team teachers for participating were because of an interest in entomology and a desire to interact with scientists, and to obtain instructional materials. These results are reported in Table 3.

Insert Table 3 about here.

Perceived barriers to implementing WOWBug activities in their home schools were largely unreported by the Development Team members. The noteworthy exception is the case of adequate facilities, with half believing that their current facilities would prove to be a barrier to teaching with the WOWBug. The Pilot Group teachers saw a few more potential barriers. Most of the barriers were instrumental in nature, such as the lack of adequate facilities, a personal lack of knowledge , or availability of culture medium. Factors related to the school climate, such as the support of fellow teachers or administration, were not deemed as potential barriers by members of either the Development Team or Pilot Group. These results are summarized in Table 4.

Insert Table 4 about here.

Evaluation of the August 1994 Workshop

In addition to the data gathered from the Pilot Groups and Development Teams as separate entities, the August 1994 workshop was evaluated by all participants using a one page Likert-type questionnaire. Participants were asked for their impressions regarding the location, structure, organization, and format of the workshop. Most of the results projected a very favorable image of the workshop, with only a few participants expressing any unfavorable feelings. A small number of participants felt that the workshop was less than well organized. The written comments of these participants, however, centered on the lack of immediate availability of travel reimbursement or stipend. The vast majority of the participants felt that the workshop was an overall success and would encourage others to participate . These results are summarized in Table 5.

Insert Table 5 about here.

Implementation Concerns

Data regarding the teachers' concerns about implementing WOWBug activities in their classes were collected using the 35-item Stages of Concern Questionnaire (SoCQ). The profile generated from SoCQ scores provides information about the "feelings, perceptions, and attitudes of individuals" toward implementing an innovation (Hall & George, 1979). The stages of concern profile for the Pilot Group is based on data collected near the end of the August workshop and is presented in Figure 1. The profile indicates that the Pilot Group, having participated in the workshop, had a general awareness of the WOWBug project but wanted more information. The greatest overall concern expressed by the Pilot Group was for coordination and cooperation with others associated with the project. We suspect that this concern reflects the teachers' dependence on the project staff for living materials and activity ideas, and the teachers' desire for collegial support when implementing an innovation. Lesser concerns were expressed about personal involvement in the project, management of project resources, and consequences associated with implementing the project. How to improve the project or to increase its impact was of little concern to members of the Pilot Group.

Insert Figure 1 about here.

Members of the Development Team also completed the SoCQ in February 1994 and again August 1994. The February stages of concern profile for the Development Team is almost identical to that for the Pilot Group. The profile generated from data collected in August is that of a more experienced user of the innovation. As can be seen in Figure 2, informational concerns have decreased markedly, while personal and management concerns have also decreased slightly. On the other hand, concerns for consequences, collaboration, and refocusing have become more intense. These shifts indicate that members of the Development Team are becoming more familiar with and skilled in using the WOWBug in teaching life science concepts and science process skills.

Insert Figure 2 about here.

Classroom Implementation

Sixth grade students in one classroom began their study of the WOWBug in the role of scientists investigating a mystery organism. The teacher began by explaining that the students were working in conjunction with scientists from The University of Georgia. Their job as student-scientists was to observe the organism, reflect on their observations, and carefully document both their observations and reflections. In this investigation, the students' primary goal was to identify the "Mystery Organism". To start the investigation, students were given vials in which *Melittobia* eggs had been laid 2 or 3 days before on the mud dauber host larva. Students were given no further information about the mystery organism at this point in the study.

The teacher's role in the study was that of facilitator. She established 4-member student working teams, provided materials for each team, asked questions of students as they worked, and gave instructions on how to document observations and reflections.

During the days of the study, the students recorded what they observed in word and drawing. They drew daily inferences concerning the identity of the mystery organism. Even though the students implored daily to be told what "it" was, no clues were given by the teacher that would help them identify the organism. Overall, most students seemed more concerned with identifying the organism than on keeping careful daily records of what they observed.

At first, the students thought the mystery organism was a butterfly pupae, then a worm. Later, as they saw the *Melittobia* adult emerge, their reflections dwelled on whether the organism was a fly, an ant, or a wasp. Students were free to collaborate with their teammates and other classmates. Of the 19 students in the class, 17 said that the mystery organism is a wasp, while two said that it is a fly.

Students were then asked to draw their best representation of a fly, an ant, and a wasp. Of the 19 students, none drew the wasp with four wings (a prime characteristic of Hymenoptera), 15

drew stripes on the abdomen, 14 drew a pointed abdomen, and 11 drew a sting emerging from the abdomen. Samples of the students' wasp drawings are shown in Figure 3.

Insert Figure 3 about here.

At this point in the study, the teacher lead the class in a" guided drawing exercise" of the adult *Melittobia* as seen with magnification. First, students were instructed to draw the body sections (i.e., head, thorax and abdomen) in proportion to one another. Next, students were asked to examine the eyes, to note their positioning on the head and their size and shape, and to add the eyes to their drawings. Then, students observed the shape and positioning of the antennae in relationship to the eyes, and were instructed to also add these features to their drawings. As this activity progressed, students noted the wing shape and their length in relationship to the abdomen and the site of wing attachment. Finally, wings, legs, and other details (e.g., hairs, wing venation) were added to their *Melittobia* drawing. Figure 4 shows samples of the students' drawings.

Insert Figure 4 about here.

At the conclusion of the guided drawing activity, the teacher supplied each team with insect field guides and identified the pages on which drawings of ants, flies, and wasps could be found. Salient characteristics of each insect type were written on the chalk board by students. Characteristics identified by the students included the fly's large eyes and two wings; the ant's lack of wings, small eyes, and front and low antennae placement; and the wasp's four wings, large eyes and pointed abdomen. After studying the pictures in the field guides, students were instructed to examine their guided drawing of the adult mystery organism and to compare them with the drawings and characteristics of each of the three groups of insects as presented in the field guides. Then, they were asked to vote again on whether they thought the mystery organism is a fly, an ant, or a wasp. Everyone retained their original vote, 17 for wasp and 2 for fly.

When the students who identified the organism as a fly were asked why they thought so, they said that they could only see two wings. The following day, the class was shown electron micrographs of the *Melittobia* ,with four wings clearly visible. Both students who had previously identified the WOWBug as a fly immediately changed their vote to "wasp".

This guided drawing investigation proved to be an effective way for students to learn how to draw what they see while improving the accuracy of their observational skills. This activity shows that one teacher, and perhaps many more, assume students "see" proportional body size, the relative position of appendages, and detail when observing an insect. By comparing their guided drawings with field guide illustrations in this investigation, students were able to collect visual evidence. This evidence was then used by them to support their inferences (that is, their interpretations or explanations of observations) about the mystery organism's identity or to changes their inferences. In this investigation, students were able to give definitive reasons for the selections they made, even if incorrect.

Future Direction and Invitation

In the remaining year of the project, we will continue to develop and field-test WOWBug teaching materials. Our plan is to refine the 10 existing prototype activities and to develop additional activities along with a set of videotapes. The videotapes will provide information about the WOWBug and will also serve to introduce several of the activities using a format similar to that employed by the "Invitation to Inquiry" filmloops developed by the Biological Science Curriculum Study some years ago. Our work to refine in vitro rearing methods will also continue in collaboration with researchers at Texas A&M University and the United States Department of Agriculture in Gainesville, Florida. And, we will continue to promote and publicize the WOWBug as a new organism for life science instruction as we expand our Pilot Group to more than 100 teachers and share the products of our work with teachers, teacher educators, and scientists at professional meetings.

It is our hope that the enthusiasm we hold for the WOWBug is contagious. We encourage you to tell others about our project and we welcome you to contact us for more information about the 10 prototype activities and *Melittobia digitata*, the star of our work.

References

Greany, P. D., Ferkovich, S. M., & Clark, W. R. (1989). Progress toward development of an artificial diet and an in vitro rearing system for *Microplitis croceipes*. *Southwestern Entomological Supplement, 12*, 89-94.

Hall, G. E., & George, A. A. (1979). *Stages of concern about the innovation: The concept, initial verification and some implications*. Research and Development Center for Teacher Education, The University of Texas at Austin. (ERIC Reproduction No. ED 187 716).

Rotundo, G. R., Cavalloro, E., Tremblay, E. (1988). In vitro rearing of *Lysiphlebus famarum* [Hym.: Bracondae]. *Entomologica, 33*, 261-267.

Table 1

Development Team and Pilot Group Demographics

	Development Team (n=12)	Pilot Group (n=43)
School Representation		
Alone	6/50	35/81.4
Pairs	6/50	8/18.6
School System		
Metro Atlanta	5/41.7	19/44.2
Coastal Georgia	2/16.7	7/16.2
South Georgia	0/0	12/28
North Georgia	1/8.3	4/9.3
W/in 30 miles of Athens	1/8.3	1/2.3
Teaching Assignment		
5th grade	2/16.7	5/11.6
6th grade	0/0	6/13.9
7th grade	9/75	30/69.8
8th grade	1/8.3	0/0
High School	0/0	2/4.7
Highest Degree Earned		
Bachelor's	6/50	22/51.2
Master's	5/41.7	15/34.9
Specialist's	1/8.3	5/11.6
Doctorate	0/0	1/2.3
Undergraduate Major		
Elementary Education	1/8.3	5/11.7
General Education	1/8.3	9/20.9
Middle Grades Education	6/50	9/20.9
Other (e.g. English, etc.)	2/16.7	9/20.9
Not Reported	2/16.7	11/25.6
Teacher Certification		
Elementary	0/0	3/7
Middle Grades	12/100	34/79.1
Secondary	0/0	5/11.6
Not Reported	0/0	1/2.3
Age		
20-34 years	4/33.3	13/30.2
35-49 years	8/66.7	24/55.8
over 50 years	0/0	6/14
Teaching Experience		
1-5 years	6/50	13/30.2
6-10 years	5/41.7	10/23.3
11-15 years	1/8.3	6/14
more than 15 years	0/0	14/32.5
Science Teaching Experience		
1-5 years	8/66.7	18/41.8
6-10 years	2/25	12/28
11-15 years	1/8.3	5/11.6
more than 15 years	0/0	8/18.6

note: Values are presented in the format n/%.

Table 2

Entomology Teaching by Development Team and Pilot Group

Group	<1 wk	1 wk	2 wks	3 wks	4 wks	> 4 wks
Development Team	1/8%	2/17%	7/58%	1/8%	1/8%	0/0
Pilot Group	6/14%	3/7%	10/23%	15/35%	4/9%	5/12%

Table 3

Development Team and Pilot Team members' reasons for participating in WOWBug project

Reason	Development Team	Pilot Group
Interact with scientists	10/83.3	31/72.1
Obtain instructional materials	10/83.3	28/65.1
Interested in entomology	7/58.3	39/90.7
Improve life sci. teaching methods	12/100	3/7.0

note: Values are presented in the format *n*/%.

Table 4

Perceived barriers to implementing WOWBug activities by Development Team and Pilot Group

Potential Barrier	Development Team	Pilot Group
personal lack of interest	1/8	0/0
students' lack of interest	1/8	3/7.0
availability of wasps	2/17	19/43.2
adequate classroom facilities in school	6/50	24/55.8
level of support of superintendent	0/0	1/2.3
level of support of fellow teachers	1/8	2/4.7
level of support from teacher's aide	0/0	5/11.6
personal lack of knowledge	2/17	27/62.8
time to plan and prepare lessons	2/17	5/11.6
availability of culture medium	3/25	23/53.5
level of support from parents	0/0	5/11.6
level of support from building principal	0/0	3/7.0
level of support from curriculum supervisor	0/0	0/0
level of support of departmental chair	0/0	0/0

note: Values are presented in the format *n*/%.

Table 5

Teachers' evaluation of the workshop

Question	SA	A	U	D	SD
Before participating, I was worried	3/6	9/18	9/18	15/30	14/28
Uneasy about workshop at U of GA	0/0	5/10	1/2	13/26	31/62
Evening dinner was a nice start	36/72	12/24	1/2	1/2	0/0
Two days was an appropriate length	14/28	31/62	1/2	3/6	1/2
Info was useful for helping students	36/73	12/25	0/0	0/0	1/2
Culture materials useful w/students	34/68	15/30	0/0	0/0	1/2
Activities useful w/Life Science	34/68	15/30	0/0	0/0	1/2
Logbook useful with students	29/58	18/36	1/2	1/2	1/2
Materials well-chosen	16/32	29/58	3/6	1/2	1/2
Intention to use materials, activities, etc.	35/70	13/26	1/2	0/0	1/2
Workshop was well-organized	19/38	23/46	2/4	6/12	0/0
Staff was helpful	38/76	11/22	0/0	0/0	1/2
Met goal of intro *Melittobia digitata*?	38/79	9/19	0/0	0/0	1/2
Met goal of providing materials?	37/77	10/21	0/0	0/0	1/2
Met goal of estab. comm. links?	36/72	11/22	1/2	1/2	1/2
Overall success of workshop	37/74	12/24	0/0	0/0	1/2
I will encourage others to participate	38/78	9/18	0/0	1/2	1/2

note: SA= strongly agree, A=agree, U=undecided, D=disagree, and SD=strongly disagree. Values are presented in the format *n*/%.

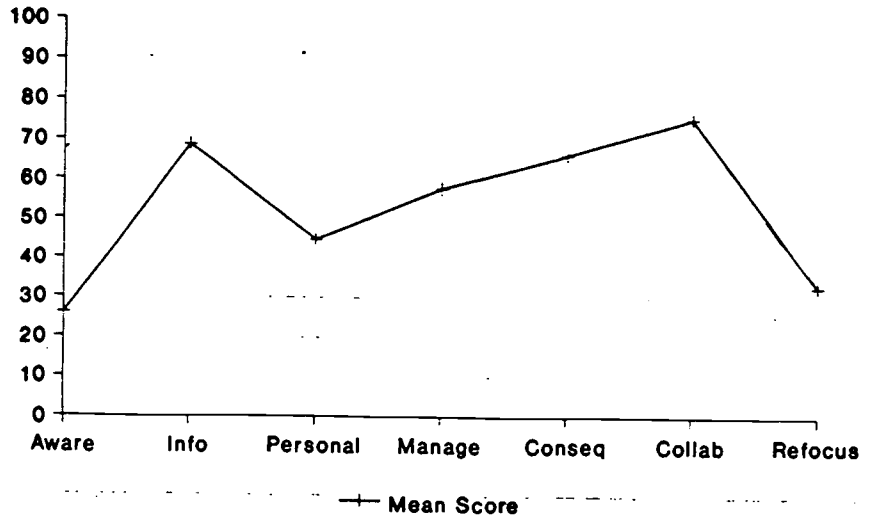

Figure 1. *Pilot Group's Stages of Concern profile*

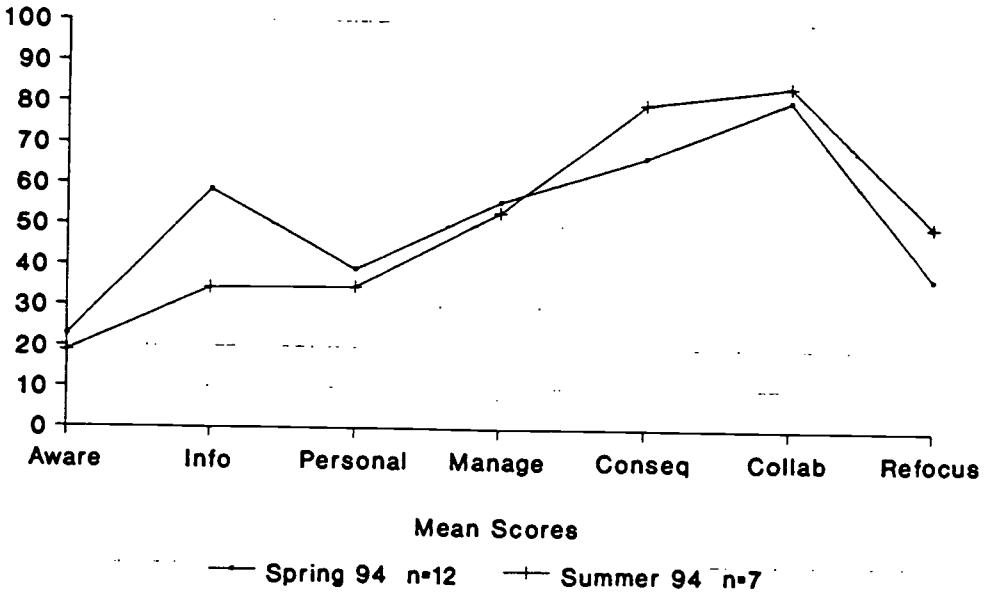

Figure 2. *Development Team's Stages of Concern profiles*

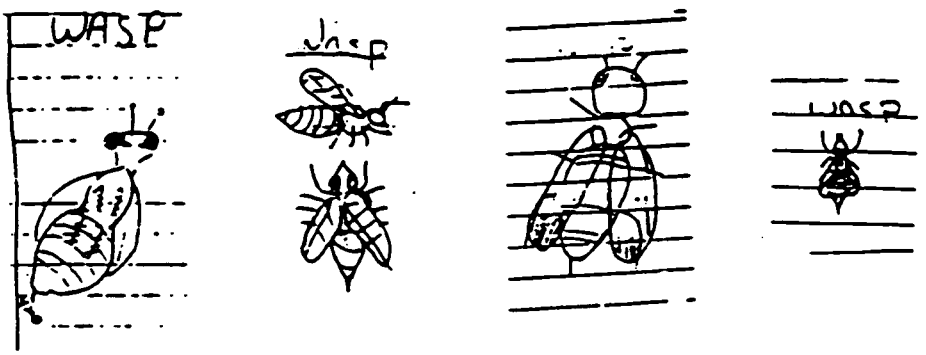

Figure 3. *Six grade students' best representations of a wasp*

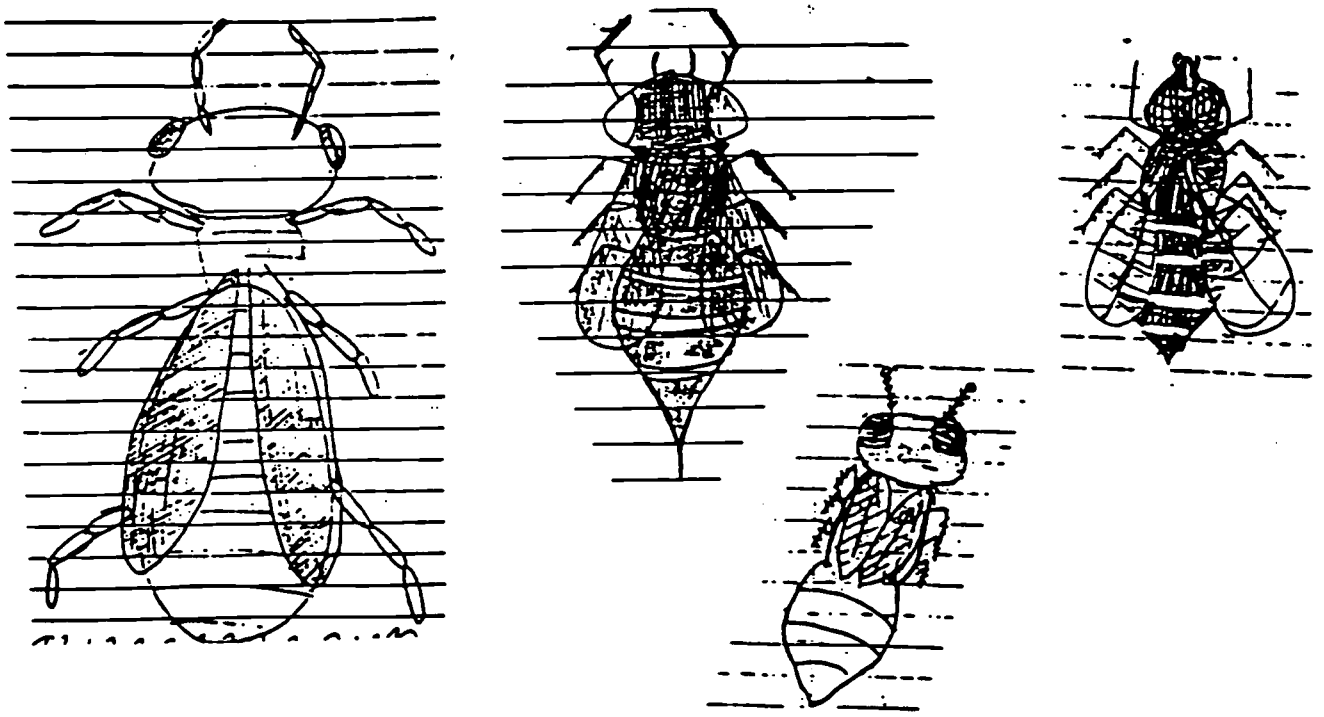

Figure 4. *Sixth grade students' guided drawings of a Melittobia wasp*

U.S. Department of Education
Office of Educational Research and Improvement (OERI)
Educational Resources Information Center (ERIC)

REPRODUCTION RELEASE

(Specific Document)

I. DOCUMENT IDENTIFICATION:

Title: WOW Bugs! Materials Development and Classroom Implementation of a Novel Organism

Author(s): Koballa, J.R., Jr., Matthews, R.W., Flage, L.R., Ranger, S. & Pyle, E.J.

Corporate Source:

Publication Date:

II. REPRODUCTION RELEASE:

In order to disseminate as widely as possible timely and significant materials of interest to the educational community, documents announced in the monthly abstract journal of the ERIC system, *Resources in Education* (RIE), are usually made available to users in microfiche, reproduced paper copy, and electronic/optical media, and sold through the ERIC Document Reproduction Service (EDRS) or other ERIC vendors. Credit is given to the source of each document, and, if reproduction release is granted, one of the following notices is affixed to the document.

If permission is granted to reproduce and disseminate the identified document, please CHECK ONE of the following two options and sign at the bottom of the page.

	The sample sticker shown below will be affixed to all Level 1 documents	The sample sticker shown below will be affixed to all Level 2 documents	
☒ Check here **For Level 1 Release:** Permitting reproduction in microfiche (4" x 6" film) or other ERIC archival media (e.g., electronic or optical) *and* paper copy.	PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY Sample TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)	PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN OTHER THAN PAPER COPY HAS BEEN GRANTED BY Sample TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)	☐ Check here **For Level 2 Release:** Permitting reproduction in microfiche (4" x 6" film) or other ERIC archival media (e.g., electronic or optical), but *not* in paper copy.
	Level 1	**Level 2**	

Documents will be processed as indicated provided reproduction quality permits. If permission to reproduce is granted, but neither box is checked, documents will be processed at Level 1.

"I hereby grant to the Educational Resources Information Center (ERIC) nonexclusive permission to reproduce and disseminate this document as indicated above. Reproduction from the ERIC microfiche or electronic/optical media by persons other than ERIC employees and its system contractors requires permission from the copyright holder. Exception is made for non-profit reproduction by libraries and other service agencies to satisfy information needs of educators in response to discrete inquiries."

Sign here → please

Signature: Thomas R. Koballa Jr.
Printed Name/Position/Title: Thomas R. Koballa, Jr. / Professor
Organization/Address: Science Education Dept. University of Georgia 212 Aderhold Hall Athens, GA 30602
Telephone: 706-542-1763
FAX: 706-542-1212
E-Mail Address: TKOBALLA@MOE.COE.UGA.EDU
Date: 01/07/97

Share Your Ideas With Colleagues Around the World

Submit your publications to the world's largest education-related database, and let ERIC work for you.

The Educational Resources Information Center (ERIC) is an international resource funded by the U.S. Department of Education. The ERIC database contains over 820,000 records of conference papers, journal articles, books, reports and non-print materials of interest to educators at all levels. Your publications can be among those indexed and described in the database.

Why submit materials to ERIC?

- **Visibility.** Items included in the ERIC database are announced to educators around the world through over 2,000 organizations receiving the abstract journal *Resources in Education (RIE)*; through access to ERIC on CD-ROM at most academic libraries and many local libraries; and through online searches of the database via the Internet or through commercial vendors.

- **Dissemination.** If a reproduction release is provided to the ERIC system, documents included in the database are reproduced on microfiche and distributed to over 900 information centers worldwide. This allows users to review materials on microfiche readers before purchasing paper copies or originals.

- **Retrievability.** This is probably the most important service ERIC can provide to authors in education. The bibliographic descriptions developed by the ERIC system are retrievable by electronic searching of the database. Thousands of users worldwide regularly search the ERIC database to find materials specifically suitable to a particular research agenda, topic, grade level, curriculum, or educational setting. Users who find materials by searching the ERIC database have particular needs and will likely consider obtaining and using items described in the output obtained from a structured search of the database.

- **Always "In Print".** ERIC maintains a master microfiche from which copies can be made on an "on-demand" basis. This means that documents archived by the ERIC system are constantly available and never go "out of print". Persons requesting material from the original source can always be referred to ERIC, relieving the original producer of an ongoing distribution burden when the stocks of printed copies are exhausted.

So, how do I submit materials?

- Complete and submit the enclosed *Reproduction Release* form. You have three options when completing this form: If you wish to allow ERIC to make microfiche and paper copies of print materials, check the box on the left side of the page and provide the signature and contact information requested. If you want ERIC to provide only microfiche copies of print materials, check the box on the right side of the page and provide the requested signature and contact information. If you are submitting non-print items or wish ERIC to only describe and announce your materials, without providing reproductions of any type, complete the back page of the form.

- Submit the completed release along with two copies of the document being submitted. There must be a separate release form for each item submitted. Mail all materials to the attention of Niqui Beckrum at the address indicated.

For further information, contact... Niqui Beckrum
Database Coordinator
ERIC/CSMEE
1929 Kenny Road
Columbus, OH 43210-1080

1-800-276-0462
(614) 292-6717
(614) 292-0263 (Fax)
beckrum.1@osu.edu (e-mail)